FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(AICTE Model Curriculum for the Academic Year 2020-2021)

and

Syllabi

B.E. V and VI-Semester

of

Four Year Degree Programme

in

Civil Engineering

(With effect from the academic year 2020– 2021)

(As approved in the faculty meeting held on 15-02-2020)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad

2020

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V – Semester
(CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC321CE**	Structural Analysis - I	3	1	-	3	30	70	3	3
2	**PC322CE**	Hydraulic Engineering	3	-	-	3	30	70	3	3
3	**PC323CE**	Structural Engineering Design and Detailing	2	1	-	3	30	70	3	3
4	**PC324CE**	Geotechnical Engineering	2	1	-	3	30	70	3	3
5	**PC325CE**	Hydrology & Water Resources Engineering	2	1	-	3	30	70	3	3
6	**PC326CE**	Transportation Engineering	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	**PC351CE**	Fluid Mechanics Lab	-	-	2	2	25	50	3	1
8	**PC352CE**	Geotechnical Engineering Lab	-	-	2	2	25	50	3	1
9	**PC353CE**	Transportation Engineering Lab	-	-	2	2	25	50	3	1
			15	**03**	**06**	**24**	**345**	**780**		**21**

PC: Professional Course
L: Lectures **T:** Tutorial **Pr :** Practical **Drg:** Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:
1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI – Semester
(CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC331CE**	Environmental Engineering	3	-	-	3	30	70	3	3
2	**PC332CE**	Estimation and Specifications	3	-	-	3	30	70	3	3
3		Professional Elective – 1	3	-	-	3	30	70	3	3
4		Professional Elective – 2	3	-	-	3	30	70	3	3
5		Professional Elective – 3	3	-	-	3	30	70	3	3
6		Open Elective – 1	3	-	-	3	30	70	3	3
7		Open Elective – 2	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
8	**PC361CE**	Environmental Engineering Laboratory	-	-	2	2	25	50	3	1
9	**PC362CE**	Computer Aided Civil Engineering Drafting, Analysis & Design Lab	-	-	2	2	25	50	3	1
10	**PC363CE**	Hydraulics Laboratory	-	-	2	2	25	50	3	1
			21	**-**	**06**	**27**	**285**	**640**		**24**

Professional Elective – 1			**Professional Elective –3**		
S. No.	**Course code**	**Course title**	**S. No.**	**Course code**	**Course title**
1	**PE301CE**	Design of Hydraulic Structures	1	**PE309CE**	Steel Structures
2	**PE302CE**	Structural Analysis –II	2	**PE310CE**	Ground Water Engineering
3	**PE303CE**	Foundation Engineering	3	**PE311CE**	Geotechnical Design
4	**PE304CE**	Railway and Airport Engineering	4	**PE312CE**	Environmental Impact Assessment of Transportation Projects

Professional Elective – 2

S. No.	Course code	Course title			
1	**PE305CE**	Design of Concrete Structures-I			
2	**PE306CE**	Traffic Engineering and Management			
3	**PE307CE**	Sustainable Construction Methods			
4	**PE308CE**	Open Channel Flow & River Engineering			

Open Elective – 1			**Open Elective – 2**		
S. No.	**Course code**	**Course title**	**S. No**	**Course code**	**Course title**
1	**OE350CE**	Remote Sensing & Geographical Information	3	**OE353CE**	Principles of Green Building Practices
2	**OE351CE**	Road Safety Engineering	4	**OE354CE**	Disaster Mitigation & Management

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective
L: Lectures T: Tutorials Pr : Practical Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
*2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core / Elective
PC 302 CE	**STRUCTURAL ANALYSIS - I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mechanics of Materials & Structures	**3**	**1**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Understand the advantage of statically indeterminate structure over the statically determinate structure.
2) Understand basic methods for the analysis of statically indeterminate beams and frames and know the difference between different methods.
3) Evaluate the displacements and redundant forces using energy principles.
4) Understand the analysis of structural elements subjected to moving loads & the analysis of road/railway bridges and gantry girders, arches.
5) Explain the concepts involved in the analysis of suspension cable bridges.

Course Outcomes

After Completion of this course, the student will be able to

1) Solve statically indeterminate beams and portal frames using classical methods
2) Sketch the shear force and bending moment diagrams for different loading condition for indeterminate structures.
3) Sketch ILD for bending moment and shear force, for determinate girders for different position of loading system and for different sections of girder
4) Analyze cable suspension bridges along with three hinged stiffening girder for static loads.
5) Analyze the three hinged arches for moving loads.

UNIT - I

Slope deflection method: Application of the method to continuous beams with and without sinking of supports, single bay - portal frames (Degree of freedom not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - II

Moment distribution method: Application of the method to continuous beams with and without sinking of supports, portal frames (static indeterminacy not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - III

Kani's Method: Application of the method to continuous beams with and without support sinking, portal frames (static indeterminacy not exceeding three), and loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT – IV

Curves of maximum bending moment and shear force: for simply supported girders traversed by (l) single point load, (2) two point loads, (3) uniformly distributed-load longer/shorter than span, enveloping parabola and EUDL (4) several point loads not exceeding four.

Moving loads: Influence line for support reaction, bending moment and shear force at any location for simple beams. Determination of maximum bending moment and shear force for moving load systems on simply supported girders.

UNIT – V

Moving loads on trusses / girders: Influence lines for forces in members of statically determinate plane framed structures under moving loads for Warren girder, Pratt truss, and Curved flange truss.

Suspension bridges: Influence lines for horizontal and vertical components of tension in the cable, tension in the cable, bending moment and shear force.

Arches: Influence lines for horizontal thrust, bending moment, normal thrust and radial shear for three hinged arches.

Suggested readings:

1. *D.S. Prakash Rao, "Structural Analysis - A Unified Approach", University Press,1996*
2. *Kinney, J. Sterling," Indeterminate Structural Analysis", Oxford Book Company,*
3. *B.C. Punmia, Er.A.K.Jain and Dr.A.K. Jain, "Theory of structures", Laxmi Publications, New Delhi,2018.*
4. *G .S, Pandit, S. P. Gupta and R. Gupta, "Structural Analysis, A Matrix Approach", Tata McGraw Hill, New Delhi,2008.*
5. *C.S.Reddy,"Basic Structural Analysis", Tata McGraw-Hill Publishing Co. Ltd., 3rd Edition, New Delhi,2010.*
6. *S.S.Bhavikatti,"Structural Analysis" – Vol. I & II, Vikas publication House Pvt. Ltd., 4thEdition, 2011.*
7. *Ramamrutham. S., "Theory of Structures", Dhanpath Rai& Sons, New Delhi,2014.*

Course Code	Course Title						Core / Elective
PC322CE	**HYDRAULIC ENGINEERING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Fluid Mechanics	3	0	0	0	**30**	**70**	**3**

Course Objectives

1) To introduce the students to various hydraulic engineering problems in open channel flows
2) Ability to understand energy loss principles
3) Ability to relate the theory and practice problems in hydraulic engineering

Course Outcomes

After Completion of this course, the student will be able to

1) Categorize various types of flows.
2) Solve various Engineering problems in Open Channels
3) Understand the hydraulic jump and its uses
4) Understand the Dimensional analysis.
5) Apply their knowledge of fluid mechanics in addressing problems in hydraulic machinery

UNIT -I:

Flow though pipes – Reynolds experiment, Laminar flow and Turbulent flow, Lower critical Reynolds number, characteristics of laminar and turbulent flows.

Velocity and shear stress distribution in laminar flow through circular pipes – Hagen Poiseuille equation, head loss in laminar flow.

Loss of head through pipes - Darcy Weisbach equation, Darcy friction factor for laminar flow, Velocity profile of Turbulent flow, empirical relations for turbulent flows, hydro dynamically smooth and rough boundaries, Moody's diagram.

Minor losses, hydraulic gradient line, Pipe flow systems - Pipes in series, equivalent pipes, pipes in parallel

UNIT-II:

Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity and pressure distribution across channel section.

Uniform Flow: Characteristics and development of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n". Most economical section of channel. Computation of Uniform flow, Normal depth.

UNIT-III:

Steady Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions**.**

Steady RVF - Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses

UNIT-IV:

Dimensional Analysis and Hydraulic Similitude: Rayleigh method, Buckingham Pi theorem andDimensionless groups. Hydraulic Similitude, Laws of similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problems.

UNIT -V

Turbines and pumps – classification of turbines, work done and efficiency in Pelton Wheel, Francis Turbine and Kaplan Turbine. Unit quantities and specific speed. Performance characteristics of turbines.
Centrifugal Pump: Components and functioning of centrifugal pump – manometric head and efficiency, work done by the impeller, Priming of pump and minimum starting speed, specific speed and performance of centrifugal pumps.

Suggested readings:

1. *Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House, 2017*
2. *Fluid Mechanics And Hydraulic Machines, K. Subramanya, Tata McGrawHill, 2018*
3. *Flow in Open channel, K. Subramanya, Tata McGrawHill, 2019*
4. *Open Channel Hydraulics, Ven Te Chow, The Blackburn Press, 2009*

Course Code	Course Title						Core/ Elective
PC323CE	**STRUCTURAL ENGINEERING DESIGN AND DETAILING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**1**	**0**	**0**	**30**	**70**	**3**

Course Objectives

The Objective of This Course is to

1) Provide a solid background of principles of structural design of Reinforced Concrete Members.
2) Provide Hands- on- experience and skill to design structural Reinforced Concrete elements.
3) Develop an understanding of real-world design problems.

Course Outcomes

After Completion of this course, the student will be able to

1) Adopt the design philosophies of Limit State method of Design and design a singly reinforced section.
2) Design of Doubly reinforced and T- Beams for flexure,
3) Design a Reinforced Concrete Beam for shear and torsion.
4) Design a Reinforced concrete one way and two-way slabs.
5) Design of Short axially loaded columns and isolated rectangular Reinforced concrete footing.

UNIT- I

Introduction: Safety and sustainable development in performance. Materials used in reinforced concrete (Cement, sand, coarse aggregate, water and reinforcing bars). Introduction to Relevant IS codes (IS 456-2000, IS 875 part I to IV). Dead load, imposed load, wind load and earthquake load.

Working stress method: Design of RCC beams - Balanced, under-reinforced and over reinforced sections

Limit State Method of Design: Introduction to the design of Concrete Structures using Limit state method of design. Design philosophies. Partial safety factors for material strength and Loads. Limit State of Collapse and Limit State of Serviceability.

Limit state of Collapse – Flexure: Assumption made in Limit state of collapse- flexure. Stress blocks Parameters, Moment of Resistance of a singly reinforced section. Analysis and design of a singly reinforced section for flexure.

UNIT- II

Design of Doubly Reinforced Beams: Analysis and Design for flexure a doubly reinforced Rectangular section.

Design of T- Beams: Analysis and Design of Singly and doubly reinforced T Beams for flexure.

UNIT- III

Design of beam for Shear: Types of Shear failure of an R.C.C beam, Shear carrying capacity of a reinforced concrete Beam. Analysis and Design of a reinforced section for Shear.

Design of Beam for Torsion: Analysis of R.C.C beam for Torsion. Equivalent Shear and Equivalent Bending Moment. Design and detailing of R.C.C beam subjected to Torsion.

Design of Beam for Bond: Flexural Bond, Anchorage (Development) Bond, Check for Bond Failure.

UNIT – IV

Design of Slabs: Types of Slabs**,** Solid slab, Ribbed and Hollow slabs, Introduction to Flat slab.

One Way Slabs: Analysis and design and detailing of simply supported and continuous one way slabs**.** Check for deflection of simply supported one way slab.

Two Way Slabs: Analysis of two way slab, yield line theory. Design and detailing of simply supported and restrained two way slabs using IS code coefficients.

UNIT- V

Limit State of Collapse – Compression: Assumptions made in Limit state of Collapse-Compression.

Design of Columns: Analysis and Design and detailing of Short axially loaded rectangular and circular column. Analysis and design of short Uni-axial and Bi-axial columns using Interaction Diagrams. Design of lateral ties.

Design of Footings: Introduction and types of Footings, Isolated footing, combined footing and Raft foundation.

Design of Isolated rectangular footing of uniform and varying depth.

Suggested readings:

1. *David Darwin, Charles W. Dolan, Arthur H. Nilson, "Design of Concrete Structures" , 15th Edition, McGraw Hill, 2016.*
2. *S.U.Pillai and D.Menon. "Reinforced concrete Design" Third Edition. McGraw Hill, 2009.*
3. *H. J. Shah, "Reinforced Concrete (Elementary reinforced concrete)", 11th Edition, Volume I, Charotar Publications, 2016.*
4. *B. C. Punmia, "Reinforced concrete structures", 7th Edition, Laxmi Publications, 1992.*
5. *A.K Jain, "Reinforced Concrete- Limit State Design", 7th edition, Nem Chand and Bros publications,2012.*
6. *N.V. Ramana Rao and P Sreenivas Sharma, " Design of Reinforced Concrete Structures", Academic Publishing Company, 2012*

Course Code	Course Title						Core / Elective
PC324CE	**GEOTECHNICAL ENGINEERING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Geology	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Introduction of Particulate Mechanics further to the solid and fluid mechanics
2) Characterization and classification of soils based on laboratory and field experiments
3) Understand Seepage, Strength and Compressibility characteristics of soils and learn the analysis of applications involving them

Course Outcomes

1) Competence in understanding the soil and the mechanisms associated with it.
2) Ability to analyze the systems involving soil mechanics
3) Competence for application of principles of soil mechanics in Foundation Engineering to be learned in the next semester.
4) Ability to analyze Compaction and consolidation Process in soils
5) Ability to analyze Earth Pressure States of earth pressure

UNIT - I

Origin & Classification of Soils: Soil as a pseudo-elastic three phase particulate medium Physical Properties of soil: Weight ratios (Water content, Density, Unit weights, Specific Gravity); Volume ratios (void ratio, porosity, degree of saturation, relative density); Interrelationships, Laboratory tests for determination of Index properties. Classification and Identification of soils for general and engineering purposes as per IS: 1498-1970.

UNIT - II

Soil moisture states: Held and Free moisture

Capillarity in Soils: Surface tension and capillary rise in soil, Capillary tension, Capillary pressure. pF value.

Permeability of Soils: Darcy's law for flow through soils - validity of Darcy's Law - Factors affecting permeability - Laboratory tests for determination of co-efficient of permeability (constant head, variable head permeability tests) - Field tests (Pumping in and pumping out tests) - Equivalent permeability of stratified soils.

Seepage in Soils: Seepage flow, seepage pressure - Flow nets - Locating phreatic line in a homogeneous earthen dam using Kogeny's parabola - Computation of seepage quantity.

Stress in Soils: Total, effective and neutral stress distribution in different ground conditions

Quick Sand phenomena: Critical Hydraulic gradient, Remedial measures

UNIT-III

Compaction Process: Compaction Mechanism; factors affecting compaction. Laboratory determination of compaction characteristics-standard and modified Proctor tests- IS Light and heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control

Consolidation Process: Spring analogy - Void ratio and effective stress (e Vs logP) relationship – Terazaghi's theory of one-dimensional consolidation - assumptions and derivation of GDE – Computation of magnitude of settlement and time rate of settlement.

UNIT – IV

Shear Strength: Significance of Shear strength in soils - Mohr - Coulomb equation - shear parameters - Laboratory tests for determination of shear strength - Direct shear test, Tri-axial compression test, Un-confined compression test, Vane shear test, Factors affecting shear strength of cohesion-less and cohesive soils.

UNIT - V

Earth Pressure: States of earth pressure - Active, passive, at rest condition; Rankine's theory: computation of active and passive earth pressure in c-less and cohesive soils; Coulomb's Wedge theory: Rehbhan's graphical solution: stability of earth retaining gravity wall.

Slope stability: Definition and classification of slopes -types of slope failure - Factors of safety with respect to cohesion, angle of shearing resistance, Height - Analysis of stability of slope using Swedish slip circle method and Taylor's stability number.

Suggested readings:

1) *Lambe, T.W. and Whitman, R.V., "**Soil Mechanics",** John Wiley &Sons Inc., NY,1969.*
2) *Donald. P. Coduto, "Geotechnical Engineering", Mc Graw HillPublications*
3) *Venkataramaiah, C., **"Geotechnical Engineering",** New Age Publishers,2006.*
4) *Murthy, V.N.S., "**Soil Mechanics and Foundation Engineering".** Dhanpat Rai & Sons,2006.*
5) *Arora, K.R., "**Soil Mechanics and Foundation Engineering",** Standard Publishers Distributors, revised and enlarged sixth edition,2007.*
6) *S.P. Brahma, **"Foundation Engineering",** Tata McGraw Hill Publishing Company Limited, New Delhi,1985.*
7) *Relevant ISCodes*

Course Code	Course Title						Core / Elective
PC325CE	**HYDROLOGY AND WATER RESOURCES ENGINEERING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives:

The students will have ability to

1) Understand the interaction among various processes in the hydrologic cycle
2) Familiar with basic concepts and assessment of groundwater flows.
3) Description regarding planning and design aspects of different types of distribution systems

Course Outcomes

At the end of the course, students must be in a position to:

1) Find out average rainfall in a catchment area and various losses
2) Develop relationship between Rainfall-Runoff
3) Understand the basic aquifer parameters and estimate ground water resources for different hydro-geological boundary conditions.
4) Determination of crop water requirement
5) Assimilation of the knowledge for various concepts of canal design.

UNIT - I

Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.

Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, Probable Maximum Precipitation (PMP), rainfall data in India.

Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, infiltration, infiltration capacity, measurement of infiltration, infiltration indices.

UNIT - II

Runoff - runoff volume, SCS-CN method of estimating runoff volume, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph, Design flood-m SPF, PMF, flood control, flood frequency studies by Gumble's method

UNIT - III

Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics, steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

UNIT - IV

Water withdrawals and uses – water for energy production, water for agriculture, water for hydroelectric generation; Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta, Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

UNIT - V

Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge, Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime cannels. Canal outlets: non-modular, semi-modular and modular outlets. Proportionality, Sensitivity and flexibility, Lining of canals, types of lining, Drainage of irrigated lands: necessity, methods.

Suggested readings:

1. *K Subramanya, "Engineering Hydrology",4th Edition, Mc-GrawHill, 2013*
2. *Kedar Mutreja, "Applied Hydrology", Tata Mc-GrawHill, 1996*
3. *G L Asawa, Irrigation and water resource Engineering, New Age Publishers, 2005.*
4. *Larry W Mays, Water Resources Engineering, John Wiley & Sons, 2000.*
5. *Punmia, B.C., Pande B. and Lal, B., "Irrigation and Water Power Engineering", 16th edition, Laxmi Publications, 2016.*
6. *S.K.Garg, "Irrigation Engineering and Hydraulic Structures", 35th edition, Khanna publishers,2016*

Course Code	Course Title						Core/Elective
PC 326CE	**TRANSPORTATION ENGINEERING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Understand the need of highways and its classification as per IRC codes
2) Design the highway geometrics as per standard code of practice
3) Study various traffic studies including analysis and design
4) Study of Airport & Railway Engineering.

Course Outcomes

On completion of the course, the students will be able to:

1) Carry out surveys involved in planning and highway alignment
2) Design the geometric elements of highways and expressways
3) Carry out traffic studies and implement traffic regulation and control measures.
4) Characterize pavement materials, design flexible & rigid pavements as per IRC
5) Understand elements of Railway & Airport Engineering

UNIT-I

Highway development and planning: Classification of roads, road development in India, Current road projects in India, National Transport Policy Recommendations, IRC, CRRI, Vision 2021, NHDP, PMGSY.

Alignment: Engineering Surveys for alignment, horizontal alignment- super elevation, extra widening and transition curves, vertical alignment- gradient, grade compensation, summit and valley curves.

UNIT-II

Geometric design of highways: Introduction, cross sectional elements - camber, sight distance stopping distance and overtaking sight distance.

Traffic engineering & control: Traffic Characteristics, traffic engineering studies, traffic flow, Level of service and capacity, traffic regulation and control, Traffic Signs and road markings, roundabouts, types of traffic signals.

UNIT-III

Pavement materials: Materials used in Highway Construction- Desirable properties of Road aggregates and tests. Types of paving binders – Paving grade bitumen, modified bituminous binders, cut-back bitumen, and Bitumen emulsion, Tests on Bitumen, Grading of bitumen, Bituminous paving mixes.

UNIT-IV

Design of pavements: flexible pavements, factors affecting design and performance; stresses in

flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC, construction joints - expansion joints, contraction joints. Functions of dowel and tie bars.

UNIT–V

Railway Engineering: Different types of gauges, Permanent way component parts and its functions. Rails – various types and functions, creep of rails, coning of wheels, Track fittings and fastenings, Sleepers- various types and functions, merits and demerits, ballast, various types and functions and sub grade preparation, Points and Crossing, Turnouts.

Airport Engineering: Introduction to air transportation, Typical airport layouts, airport classification as per landing & take-off and dimensions. Factors for airport site selection.

Runway Design: Runway orientation, basic runway length, correction for elevation, temperature and gradient.

Suggested readings:

1. *Khanna S.K., Justo C.E.G., Veeraraghavan A., "**Highway Engineering**", 10thEdition, NemChand&Bros,2015*
2. *KadiyaliL.R,"**TrafficEngineeringandTransportationPlanning"**,KhannaPublishers,2016*
3. *ITE Hand Book, Highway Engineering Hand Book, Mc Graw - Hill.*
4. *Srinivasa Kumar R., "Pavement Design", Orient Blackswan Pvt. Ltd., New Delhi, 2013.*
5. *R.Srinivasa Kumar, Transportation Engineering (Railways, Airport, Docks Harbour), Universities Press, 2014.*

Course Code	Course Title						Core / Elective
PC351CE	**FLUID MECHANICS LAB**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1) Students should be able to verify the principles studied in fluid mechanics
2) Ability to perform the experiments in laboratory

Course Outcomes

1) Ability to measure flow in closed conduits and flumes
2) Application of Bernoulli's principle in Hydraulics
3) Computation of various losses in pipes and pipe fittings

List of Experiments

1. Determination of coefficient of discharge of a Rectangular Notch with end contractions
2. Determination of coefficient of discharge of a Circular orifice
3. Determination of coefficient of discharge of a Mouth piece
4. Determination of coefficient of discharge of V- Notch
5. Determination of coefficient of discharge of a Venturimeter
6. Determination of coefficient of discharge of an Orifice meter
7. Classification of flow by Reynold's Experiment
8. Determination of Darcy's friction factor
9. Verification of Bernoulli's theorem
10. Flow visualization by Heleshaw model

e-Resources:

1. *http://nptel.ac.in/*
2. *http://mhrd.gov.in/e-contents*
3. *http://vlab.co.in/*

Course Code	Course Title						Core / Elective
PC352CE	**GEOTECHNICAL ENGINEERING LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1) Expose the students to different types of soils
2) Experience the concepts of soil mass, soil solids, and soil structure.
3) Understand the laboratory test procedures and appreciate the suitability of each test.
4) Make the students to relate theoretical concepts in doing lab tests.

Course Outcomes

1) Competence in performing the laboratory experiments on soil specimen, analyse the results, interpret and validate the same
2) Greater insight in to the soil behavior and hence enhanced understanding of soil mechanics
3) Ability to model a field application in the laboratory to take up research
4) Competence in performing, analyze the results of Direct Shear Test
5) Ability to analyze shear parameters in calculation of Bearing capacity of soils

DETERMINATION OF INDEX PROPERTIES:

1. Determination of Specific Gravity of soil solids using Density bottle method
2. Determination of Specific Gravity of Soil Solids using Pycnometer method
3. Determination of water content using Pycnometer method
4. Determination of Liquid limit using Casgrande's standard LLdevice
5. Determination of Liquid limit using Cone Penetration apparatus
6. Determination of Plastic limit and Shrinkage limit
7. Sieve Analysis for plotting Particle size distribution curve.
8. Determination of Field Density using Sand Replacement Method

DETERMINA TION OF ENGINEERING PROPERTIES:

9. Determination of Compaction Characteristics
10. Determination of Co-efficient of Permeability by Constant Head Permeameter test
11. Determination of Co-efficient of Permeability by Variable Head Permeameter test
12. Determination of shear strength, parameters by Direct Shear Test
13. Determination of shear strength Cohesive soils by Unconfined Compression test
14. Determination of shear strength by conducting Vane Shear Test

DEMONSTRATION OF TEST PROCEDURE:

15. Consolidometer test
16. Tri-axial compression Test
17. Laboratory Plate Load Test
18. Reverse Osmosis Test
19. Quick Sand Model
20. Cyclic Tri-axial Test Facility

Note: *At least ten experiments should be conducted in the Semester*

Suggested readings:

1) *IS: 2720 – Relevant Parts.*
2) *Lambe, T.W., **"Soil Testing for Engineers",** Wiley Eastern Ltd., New Delhi, 1969.*
3) *S.Mittal, "Soil Testing for Engineers", Khanna Publishers, 1992.*

Course Code	Course Title						Core/Elective
PC353CE	**TRANSPORTATION ENGINEERING LAB**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1) Know the properties of various road materials
2) Create the awareness about various traffic studies in the field

Course Outcomes

On completion of the course, the students will be able to:

1) Characterize the pavement materials.
2) Perform quality control tests on pavement material and pavements.
3) Conduct traffic studies for estimation of traffic flow characteristics.

List of Experiments:

A) Tests on Bitumen

1) Penetration Test.
2) Ductility Test
3) Softening point test
4) Specific gravity test
5) Viscosity test
6) Flash and fire point test

B) Tests on Road Aggregate

7) Aggregate crushing value test
8) Los Angeles abrasion test
9) Aggregate impact value test
10) Aggregate shape test (flakiness & elongation)
11) Specific gravity
12) Water Absorption
13) Soundness

C) Experiments on Traffic

14) Traffic Volume study (a) at mid-section (b) at intersection
15) Spot speed study
16) Speed and delay study
17) Origin and Destination Study

D) Miscellaneous Tests (Demonstration Only)

18) Marshal stability test
19) Determination of C.B.R.
20) Benkelman beam test
21) Bitumen extraction test
22) Exposure to Latest Software in the field of Transportation Engineering

Note: At least ten experiments should be conducted in the Semester

Suggested readings:

1. Relevant IS and IRC Codes of Practice.
2. Relevant ASTM and AASHTO Codes of Practice
3. Khanna, S. K. and Justo, C.E.G., Highway Material Testing (laboratory manual). Nem Chand & Bros, Roorkee (2000)

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI – Semester (CIVIL ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	**PC331CE**	Environmental Engineering	3	-	-	3	30	70	3	3
2	**PC332CE**	Estimation and Specifications	3	-	-	3	30	70	3	3
3		Professional Elective – 1	3	-	-	3	30	70	3	3
4		Professional Elective – 2	3	-	-	3	30	70	3	3
5		Professional Elective – 3	3	-	-	3	30	70	3	3
6	**OE**	Open Elective – 1	3	-	-	3	30	70	3	3
7		Open Elective – 2	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
8	**PC361CE**	Environmental Engineering Lab	-	-	2	2	25	50	3	1
9	**PC362CE**	Computer Aided Civil Engineering Drafting, Analysis & Design Lab	-	-	2	2	25	50	3	1
10	**PC363CE**	Hydraulics Laboratory	-	-	2	2	25	50	3	1
			21	**-**	**06**	**27**	**285**	**640**		**24**

Professional Elective – 1			**Professional Elective –3**		
S. No.	**Course code**	**Course title**	**S. No.**	**Course code**	**Course title**
1	**PE301CE**	Design of Hydraulic Structures	1	**PE309CE**	Steel Structures
2	**PE302CE**	Structural Analysis –II	2	**PE310CE**	Ground Water Engineering
3	**PE303CE**	Foundation Engineering	3	**PE311CE**	Geotechnical Design
4	**PE304CE**	Railway And Airport Engineering	4	**PE312CE**	Environmental Impact Assessment of Transportation Projects

Professional Elective – 2

S. No.	Course code	Course title
1	**PE305CE**	Design of Concrete Structures-I
2	**PE306CE**	Traffic Engineering and Management
3	**PE307CE**	Sustainable Construction Methods
4	**PE308CE**	Open Channel Flow & River Engineering

Open Elective – 1			Open Elective – 2		
S. No.	**Course code**	**Course title**	**S. No**	**Course code**	**Course title**
1	**OE350CE**	Remote Sensing & Geographical Information	3	**OE352CE**	Principles of Green Building Practices
2	**OE351CE**	Road Safety Engineering	4	**OE353CE**	Disaster Mitigation & Management

PC: Professional Course **PE**: Professional Elective **OE**: Open Elective
L: Lectures T: Tutorials Pr : Practical Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
*2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core / Elective
PC331 CE	**ENVIRONMENTAL ENGINEERING**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Fill the gap between general introductory environmental science and the more advanced environmental engineering
2) Explain the different sequential unit operations of water and wastewater treatment processes
3) Provide necessary engineering principles for analyzing the environmental issues
4) Motivate the present and future generations to take suitable care of sustainability of all existing resources

Course Outcomes

On completion of the course, the students will be able to:

1) Forecast water demands for water supply in the societal context.
2) Design environmental engineering systems including the considerations of risk and environmental impacts.
3) Characterize sewage systems and design sewers and appurtenances
4) Understand and design sludge disposal systems and septic tanks
5) Categorize air and noise pollution impacts and standards

UNIT -I

Water supply: Objectives of protected water supplies, rate of demand, population forecasts, surface and ground water sources of water, analysis of water, Classification, description, and design of Coagulation, flocculation, and sedimentation processes.

UNIT –II

Classification, description, and design of filtration, disinfection, and softening processes, Methods of layout of distribution pipes, Design of distribution by Hardy Cross method for simple net works.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery, treatment and disposal)

UNIT-III

Wastewater engineering: Definitions, system of sewerage, shapes of sewers, hydraulic formulae for design of sewers, sewer appurtenances, traps, B.O.D. and C.O.D., self purification of stream methods of disposal of sewage.

UNIT-IV

Treatment of Sewage: Principles and design of screens. grit chambers. Detritus tanks. Sedimentation tanks. Contact beds. Trickling filters. and activated sludge process. Methods of sludge disposal. Sludge digestion tanks. Principles and design of septic tanks

UNIT – V

Air Pollution: Types of pollutants, their sources and impacts air pollution meteorology and control. air quality standards and limits.

Noise Pollution: Impacts of noise. Permissible limits of noise pollution. Measurement of noise

and control of noise pollution.

Suggested readings:

1. *Fair. G. M. and Geyer. J. C. 'Water and Wastewater Engineering', vol. I and II, John Wiley & ,Sons Inc., New York, 2010.*
2. *White. J.B .. 'Wastewater Engineering', Edward Arnold. London, 1978*
3. *Hammer. M. J. and Hammer. M. J. Jr., 'Water and Wastewater Technology', Prentice-Hall of India Pvt. Ltd., New Delhi, 1998*
4. *Metcalf & Eddy. 'Wastewater Engg; treatment, disposal reuse', Tata McGraw- Hill Publishing Company Limited, New Delhi,1995*
5. *Sasi Kumar, K & Sanoop Gopi Krishna., 'Solid waste Management', PHI Publishers, 2013*
6. *Gilbert, M. Masters , 'Introduction to Environmental Engineering and Science', Prentice-Hall of India Pvt. Ltd., New Delhi, 1995*

Course Code	Course Title						Core / Elective
PC307 CE	**ESTIMATION COSTING AND SPECIFICATIONS**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**2**	**30**	**70**	**3**

Course Objectives

1) Understand the basic principles and specifications for estimations
2) Know the basic procedures for Tenders and Tender documents
3) Understand the detailed estimation of buildings, roads and Irrigation structures

Course Outcomes

On completion of the course, the students will be able to:

1) Prepare and document for detailed specification of Civil works
2) Prepare tender documents
3) Prepare estimates for various Civil Engineering structures
4) Finalize Estimates for Irrigation structures
5) Perform valuation of Civil Engineering structures.

UNIT -I

Basic principles and specifications: General and detailed specifications of works. Departmental procedures to the construction works. Types of estimates, various types of contract, turnkey projects, essentials of contracts and conditions of contracts, Schedule of rates, standard data, rate analysis, Bill of quantities.

UNIT –II

Tenders and Documentation: Tenders, preparation of tenders, tender documentation, Tender notice, work order, Earnest money deposit, and security money deposits, comparative statements, additional conditions mentioned by tender, and those implications. Measurement book and muster roll, advances in tender procedures. National bidding/International bidding/Shopping. BOT, BOOT and PPP projects. Role of IT in tenders and construction industry.

Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management

UNIT-III

Estimation of Buildings and roads: Traditional residential buildings. advanced buildings (earth work. footings, columns, beams and slabs etc) by long wall and short wall method and centre line method, bar bending schedules, estimation of reinforcement quantities, Estimation of road works using levels (Cross sections and longitudinal sections). Preparation of estimates using computer software/excel sheets/available software's, Introduction to MS project.

UNIT-IV

Estimation of Irrigation Structures: Pipe culvert, Slab culvert. Irrigation canal including

earth work (cutting and banking), Retaining walls, overhead Water tank

UNIT-V

Valuation: Basic – Principles of valuation – Value and Cost – value engineering – value analysis – phases in value engineering – information – function – escalation – evaluation – recommendation implementation

Settlement of disputes, R.A. Bill & Final Bill, Payment, Introduction to Acts pertaining to- Minimum wages, Workman's compensation, Arbitration, Easement rights.

Suggested readings:

1. *Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016*
2. *Chakraborthi, M. (2010). "Estimating, Costing, Specification and Valuation in Civil Engineering 24th Edition, M. C. Chakraborthi, Kolkata.*
3. *Jagjit Singh. (1996). "Estimating and Costing in Civil Engineering." Galgotia publications, New Delhi.*
4. *Relevant Indian Standard Specifications.*
5. *World Bank Approved Contract Documents.*
6. *FIDIC Contract Conditions.*
7. *Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration*
8. *Typical PWD Rate Analysis documents.*

Course Code	Course Title						Core / Elective
PE301CE	**DESIGN OF HYDRAULIC STRUCTURES**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Hydrology and Water Resources Engineering	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Develop the understanding of basic principles and concepts of analysis and design of hydraulic structures
2) Understand design of weirs and barrage, regulation works, dams, canals and various river training works.
3) Provide the detailed insight into the theories of diversion works

Course Outcomes

On completion of the course, the students will be able to:

1) Assimilation of the various concepts of reservoirs and design of gravity dams
2) Design the main sections of earth dams.
3) Determine Energy dissipation through spill ways
4) Application of design aspects of different types of weirs and regulatory systems
5) Usefulness of cross drainage works; canal falls and its design.

UNIT-I

Types of reservoirs: Selection of site, Storage capacity analysis, Reservoir sedimentation, Flood routing through retarding basin.

Gravity dams: Types of dams, advantages & disadvantages, selection criteria, forces acting on gravity dam, failures of gravity dam, Stability of gravity dams, principal and shear stresses, elementary and practical profiles of a gravity dam, economical height of dam, high and low gravity dams, functions, and types of galleries in gravity dams

UNIT-II

Earth Dams: Types, methods of construction, failures of earth dam, Criteria for the safe design of an earth dam, computation of seepage from flow net, phreatic line in an earth dam (for homogeneous sections with and without filter cases), design of earth dams to suit available materials, embankment and foundation seepage control measures, drainage in embankment, various types of filters

UNIT-III

Spill ways & Energy Dissipation: Types of Spill ways, ogee spill ways, design of Ogee profile, fixation of levels, siphon spill way & chutes spill way. Energy Dissipaters, Hydraulic jump & Bucket type dissipaters, Tail water rating curve & jump height curve.

UNIT-IV

Diversion Headworks: component parts of diversion headworks, types of weirs, causes of failures of weirs, remedial measures, Bligh's and Khosla's theories, design of vertical drop weir, and sloping glaciers weir.

UNIT-V

Canal Falls: Definition, location, types of falls, design of trapezoidal notch fall, cylinder fall, vertical drop fall and glacis fall.

Regulators and Modules: Head regulator and cross regulators, canal escapes

Cross drainage works: Definition, classification, design of aqueducts, siphon aqueducts, super passages, and canal siphons, inlets and outlets-selection of cross drainage works.

Suggested readings:

1. *Punmia Punmia, B.C., Pande B. and Lal, B., "Irrigation and Water Power Engineering", 16th edition, Laxmi Publications, 2016.*
2. *S.K.Garg, "Irrigation Engineering and Hydraulic Structures", 35th edition, Khanna publishers,2016*
3. *Modi P.N., "Irrigation and Water Resources and Water Power Engineering", Standard Book House, 2014*
4. *S.K.Sharma, "Irrigation Engineering & Hydraulic Structures" S.Chand Publishers, New Delhi 2016.*
5. *U.S.Bureau of Reclamation, "Design Manual for Concrete Gravity Dams", Denver, 1976.*
6. *U.S.Army Corps of Engineers, "Engineering and Design", CECW-ED Publications, 1995*
7. *Wurbs, R A. and James, W.P., "Water Resources Engineering", Prentice-Hall of India, New Delhi, 2002.*

Course Code	Course Title						Core / Elective
PE361CE	**STRUCTURAL ANALYSIS –II**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Structural Analysis	**3**	**1**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Illustrate the matrix methods of structural analysis for computer applications.
2) Analyze and evaluate Beams, Trusses and structural frames through stiffness matrices an Flexibility matrices.
3) Able to understand basics of FEM & development of structural engineering software.
4) 2D frames analysis by approximate methods

Course Outcomes

1) Develop flexibility matrix to calculate the Redundant forces and sketch the BMD and SFD.
2) Develop Stiffness matrix to calculate the displacement of joints and sketch the BMD and SFD.
3) Develop Direct Stiffness matrix for different elements and obtain member displacements and member end forces.
4) Analyze the frames using approximate methods of Analysis.
5) Understand the Basic concept of Finite Element Method.

UNIT – I

Flexibility Matrix Method: Determination of Static and kinematic indeterminacy – Equilibrium and compatibility conditions-Principles of superposition, Application of Flexibility Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Static indeterminacy not exceeding three) subjected to Concentrated forces, Uniform forces and Concentrated Moments - Effect of temperature, Lack of fit.

UNIT – II

Stiffness Matrix Method: Application of Stiffness Matrix Method to continuous beams, plane trusses, plane frames and ortho-grid structures (Degree of freedom not exceeding three) subjected to Concentrated forces, Uniform forces and Concentrated Moments.

UNIT – III

Direct Element Method: Application of direct element method to problems of axially loaded bars, continuous beams, plane trusses and plane frames (Degree of freedom not exceeding three). Introduction to Structural Analysis software packages.

UNIT – IV

Approximate methods of Analysis:

Substitute Frame Method: Substitute frame, Application of Substitute frame method of analysis of frames subjected to transverse loading. Arrangement of Live loads as per IS 456 – 2000.

Analysis of Frames subjected to Lateral loads: Analysis of Building frames subjected to Lateral loads, Portal method and Cantilever method.

UNIT-V

Introduction to Finite Element Method: Types of Problems, Types of Materials, Types of Forces, Equations of equilibrium for 3-D Continua. Variational approach, Rayleigh-Ritz method, FEM application to one dimensional element, shape function. Introduction to FEM structural engineering softwares.

Suggested readings:

1. *J. M. Gere & William Weaver, "Matrix Analysis of Framed Structures", 2nd Ed., D Van Nostand, New Jersey,1980.*
2. *D.S. Prakash Rao, "Structural Analysis - A Unified Approach", University Press,1996*
3. *G .S, Pandit, S. P. Gupta and R. Gupta, "Theory of Structures", – Vol. I & II, Tata McGraw Hill, New Delhi,1999.*
4. *C.S.Reddy,"Basic Structural Analysis", Tata McGraw-Hill Publishing Co. Ltd., 3rd Edition, New Delhi,2010.*
5. *C.S. Krishna Moorthy, Finite Element Analysis, McGraw Hill,1991.*
6. *S.S.Bhavikatti,"Structural Analysis" – Vol. I & II, Vikas publication House Pvt. Ltd., 4thEdition, 2011.*
7. *Ramamrutham. S., "Theory of Structures", Dhanpath Rai& Sons, New Delhi,2014.*
8. *S.S. Bhavakatti, Finite Element Analysis, New Age International Publishers,2005.*

Course Code	Course Title						Core / Elective
PE303CE	**FOUNDATION ENGINEERING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Learn the definition, necessity, types and suitability of different foundation systems.
2) Understand the procedures of geotechnical design of foundations.
3) Understand the necessity and usage of different foundation construction related aspects.
4) Learn about different methods of geotechnical investigations and its role in selection and design of foundations.

Course Outcomes

After Completion of this course, the student will be able to

1) Understand the stress distribution in soils.
2) Calculate bearing capacity of shallow foundation.
3) Design pile foundation and machine foundation.
4) Understand soil explorations
5) To learn various aspects of foundation.

UNIT- I

Stress Distribution in Soils: Boussinesq's theory – Computation of increment in vertical stress due to application of a point load (its distribution on horizontal, vertical planes), uniformly distributed circular and rectangular areas –Pressure bulb – Significant depth - Construction and use of Newmark's chart – Westergaard's theory – Validity of elastic theories – Contact pressure distribution.

UNIT- II

Introduction to Foundations: Functional requirements – types – differentiation of shallow and deep foundations – suitability

Safe Bearing Capacity of Shallow Foundations: Definitions - (a) Based on theories –Types of shear failures - Terazaghi's theory for safe bearing capacity of shallow foundations – Effect of type of shear failure / shape of the footing / water table – Provisions of IS: 6403-1981 (b) Based on field tests: Plate load test / Standard Penetration test

Allowable Bearing Capacity of Shallow Foundations: Settlement Analysis – Total settlement – Elastic settlement – Consolidation settlement (ultimate & after any given period – correction for construction period) – Permissible uniform & differential settlements – Proportioning of footings.

UNIT- III

Pile Foundations: Necessity – types based on load transfer mechanism / material / method of installation / functional use – Estimation of vertical load carrying capacity of a single pile – static formulae / Dynamic formulae / Pile load tests – Cyclic pile load test for separation of total capacity in to bearing and friction components – Pile groups – necessity – efficiency of Pile groups - estimation of group capacity – Negative Skin friction –Design Principles of Pile Foundations- Concept of Piled raft foundation.

UNIT – IV

Caissons: Necessity – types – Essential components of open (well) / box (floating) / Pneumatic caissons - suitability – Sinking of caissons – correction for tilt &shift.-Stability of Well Foundations

Geotechnical Investigations: Necessity – Principles of exploration - objectives – Soil profile – collection of disturbed & undisturbed soil samples – samplers & quality of samples - methods – Trial pit / Bore hole method – Log of bore hole details

UNIT- V

Foundation construction related aspects.

Timbered / braced excavations: Necessity - methods – suitability – distribution of pressure – reaction of struts.

Dewatering: Necessity – methods – sumps (ditches) / well point system (single /multi-stage) / deep well system / electro-osmosis method – merits & demerits – suitability

Coffer dams: necessity – types – suitability

Underpinning: Necessity – methods (pin / pile) - suitability

Geosynthetics: Classification – functions – applications.

Suggested readings:

1. *Joseph E.Bowles,"Foundation analysis and Design", McGraw-Hill Publications, 2001.*
2. *Das, Braja M. "Principles of Foundation Engineering", cengage Publications, 2013*
3. *Arora, K.R., "Soil Mechanics & Foundation Engineering" Standard Publications, 2009.*
4. *Varghese, P.C,. "Foundation Engineering", PHI Publications, 2005.*

Course Code	Course Title						Core / Elective
PE304CE	**RAILWAY AND AIRPORT ENGINEERING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Impart knowledge on railway engineering.
2) Understand Geometry and layout concepts of Railway systems
3) Understand Airport Planning concepts

Course Outcomes

On completion of the course, the students will be able to:

1) Understand element of permanent way and application of principles of geometric design railway track
2) To perform Engineering Surveys and geometric design of railway track.
3) Understand basic elements of turnarounds and signal in railways
4) Understand basic element of airport engineering and application of basic design concepts of runway alignment
5) Make preliminary design of Runways for airports including surface and subsurface drainage.

A: RAILWAY ENGINEERING

UNIT – I

Components of Railway Engineering: Permanent way components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast –Rail Fastenings

Creep of Rails- Theories related to creep – Adzing of Sleepers- Sleeper density – Rail joints.

UNIT – II

Geometric Design of Railway Track: Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – safe speed on curves – Transition curve – Compound curves – Reverse curves – Extra clearance on curves – widening of gauge on curves – vertical curves – cheek rails on curves.

UNIT-III

Turnouts & Controllers: Track layouts – Switches – Design of Tongue Rails – Crossings – Turnouts – Layout of Turnout – Double Turnout – Diamond crossing – Scissors crossing. Signal Objectives – Classification – Fixed signals – Stop signals – Signaling systems – Mechanical signaling system – Electrical signaling system – System for Controlling Train Movement – Interlocking – Modern signaling Installations.

B.AIRPORT ENGINEERING

UNIT-IV

Airport Planning & Design: Airport Master plan – Airport site selection – Air craft characteristics – Zoning laws – Airport classification – Runway orientation – Wind rose diagram – Runway length – Taxiway design – Terminal area and Airport layout – Visual aids

and Air traffic control.

UNIT – V

Runway Design: Various Design factors – Design methods for Flexible pavements – Design methods for Rigid pavements – LCN system of Pavement Design – Airfield Pavement Failures – Maintenance and Rehabilitation of Airfield pavements – Evaluation & Strengthening of Airfield pavements – Airport Drainage – Design of surface and subsurface drainage.

Suggested readings:

1. *R. Srinivasa Kumar, Transportation Engineering (Railways, Airport, Docks Harbour), Universities Press, 2014.*
2. *Chandra, S. and Agarwal, M.M., Railway Engineering, Oxford Higher Education,2nd Edition, University Press New Delhi, 2007*

Course Code	Course Title						Core/ Elective
PE305 CE	**DESIGN OF CONCRETE STRUCTURES-I**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	**T**	**L**	**T**			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

The Objective of This Course is to

1) Provide a good understanding of advanced concrete design.
2) Provide Hands- on- experience and skills to designing structural elements.
3) Develop an understanding of real-world design problems.

Course Outcomes

After Completion of this course, the student will be able to

1) Design and detailing Reinforced concrete flat slab.
2) Design and detailing of combined footings and retaining walls.
3) Design and detailing of Beams Curved in plan and deep Beams
4) Design and detailing of Ground level and overhead Water Tank.
5) Design and detailing of Portal Frame and Building frame.

UNIT- I

Design of Solid Slab: Design of Simply Supported and Restrained Two way Slabs using IS code method.

Design of Flat Slab: Types of Flat Slab, IS code Provision, Analysis and design of Flat Slab (Without and with Drop in Slab), Using Direct Design Method and Equivalent frame method.

UNIT- II

Design of Footing: Types of Footings, Introduction of Isolated footing, Combined Footing, Raft Foundation and Pile Foundation.

Design and Detailing of Isolated Rectangular, Square and Circular Footings, Design of Combined Rectangular and Trapezoidal Footings.

UNIT- III

Retaining Walls: Design and Detailing of Cantilever and Counter fort Retaining Walls.

Beams Curved in Plan: Introduction, design Principle, design of beams curved in plan of circular and semicircular.

UNIT – IV

Water Tanks: Introduction, Types of water tanks, Elastic Design and Detailing of R.C.C. Circular and Rectangular Ground level and overhead water tanks using IS code method.

UNIT- V

Portal Frames: Introduction, Analysis and design of rectangular portal frames including hinges at the base.

Building Frames: Substitute frame method of Analysis for building frames, Analysis and Design of frames with single bay two storeyed and two bay single storeyed.

Suggested readings:

1. *N. Krishna Raju, "Advanced Reinforced Concrete Design", CBS Publisher*
2. *H. J. Shah, "Reinforced Concrete" Volume II, Charotar Publications*
3. *B. C. Punmia, "RCC Design", Laxmi Publications*.

Course Code	Course Title						Core / Elective
PE306CE	**TRAFFIC ENGINEERING AND MANAGEMENT**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) To set a solid and firm foundation in traffic engineering management,
2) Provide concepts of traffic regulation and highway capacity,
3) Teach principles of design and introduction of traffic flow theory.

Course Outcomes

This course will enable students will be able to

1) Learn advanced topics in traffic engineering and management
2) Design hourly traffic volume including mixed traffic conditions
3) Understand the concept of highway capacity
4) Perform Accident analysis
5) Apply Queuing theory for traffic flow and understand traffic management systems

UNIT – I

Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection.

UNIT – II

Design Hourly Volume For Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, and demand functions. Determination of design hourly volume; critical hour concept.

UNIT-III

Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalized intersections. Problems in Mixed Traffic flow; Case studies.

UNIT-IV

Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions.

UNIT – V

Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications.

Traffic Management: Traffic System Management (TSM) and Travel Demand Management(TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes.

Suggested readings:

1. *Kadiyali L.R,. Traffic Engineering and Transport planning, 9th Edition, Khanna Tech Publishers, 2013.*
2. *C.E.G.Justo, A. Veeraragavan and S.K.Khanna, Highway Engineering, 10th Edition, Nem Chand Publishers, 2017.*
3. *Donald Drew, Traffic Flow Theory Chapter 14 in Differential Equation Models, Springer, 1983*
4. *Martin Whol, Brian V Martin , Traffic system Analysis for Engineers and Planners, McGraw Hill, 1967*
5. *Highway Capacity Manual, TRB Publications.*

Course Code	Course Title				Core / Elective		
PE307CE	**SUSTAINABLE CONSTRUCTION METHODS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**1**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) To be able to understand the significance of modular construction methods.
2) To study and understand the properties of sustainable building materials used in construction
3) To get a complete overview of various kinds of sustainable building rating systems and how they are used in the construction industry.
4) To be able to analyze productivity and economics in construction techniques.

Course Outcomes

On completion of this course, students are able to:

1) Understand the role of project management strategies in sustainable construction.
2) Understand the limitations of construction techniques.
3) Implement modular construction practices.
4) Understand reliable proportioning concepts in construction techniques
5) Understand and document building rating system based on Green building concept

UNIT – I

Modular Construction Practices - Introduction to formwork - requirements of formwork, loads carried by formwork, types of formwork -timber, steel, slip forms, scaffolding. Modular construction - modular coordination, modular standardization, modular system building, modular shuttering, limitation and advantages of modular construction

Unit-II

Basic Construction Methods – Construction of foundation and super structure - buildings - precast concrete structures, bridges - steel bridges, arch bridges, cantilever bridges segmental construction, box girders. Construction of special type of bridges such as cable stayed bridge, suspension and pre-stressed bridge.

UNIT – III

Sustainable Construction Materials – Overview of cutting-edge sustainable energy -efficient building materials, alternative cements and cementitious materials, sustainable issues for concrete, minimization of natural resource utilization, reduction in water consumption in concrete, recycled aggregate, evaluation of their potential to reduce the negative environmental impacts of construction activity

UNIT – IV

Innovative Methods of Construction – Slip form technology, jump form technology, aluminum form technology, tunnel form technology, dry wall technology, plastering machines.

UNIT –V

Sustainable Building Rating Systems - Rating systems for the design, construction, operation, and maintenance of green buildings through Leadership in Energy and Environmental Design (LEED), Case Study of recent green construction projects in India – Certification of LEED Green Associate professional licensing.

Suggested Reading

1. *Roy Chudley, Construction Technology - Vol. 1, 1st Edition, Pearson Education, 2014.*
2. *Robert Peurifoy, Clifford J. Schexnayder and Aviad Shapira, Construction Planning, Equipment and Methods, McGraw Hill Publication, 2010.*
3. *Relevant books on Construction Engineering, NICMAR Publications*
4. *Manuals, brochures, publications from construction companies, firms etc.*
5. *Reports of actual works executed.*
6. *Kumar Niraj Jha, Formwork for Concrete Structures, McGraw Hill Publication, 2017.*
7. *Allen Edward and Iano Joseph, Fundamentals of Building Construction: Material and Method, 6th Edition, John Wiley and Sons, 2013.*
8. *Sustainable Engineering Practice ASCE Publication 2010.*

Course Code	Course Title						Core / Elective
PE308CE	**OPEN CHANNEL FLOW & RIVER ENGINEERING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Hydraulic Engineering	3	0	0	0	**30**	**70**	3

Course Objectives

1) To develop a basic knowledge of open channel flow relationships by applying fluid properties, hydrostatics, and the conservation equations for mass, momentum, and energy
2) To gain proficiency in applying the conservation equations to open channel flow problems.
3) Knowledge about River Morphology, river protection and river restoration.

Course Outcomes

On completion of the course, the students will be able to:

1) Ability to develop the open channel flow equations from the basic conservation equations.
2) Have knowledge basics of numerical methods and fluid mechanics.
3) Competent in understanding flood routing in Channel networks.
4) Knowledge about physical river models
5) Design of river training works and flood protection structures.

UNIT-I

This course should discuss how to analyze for unsteady flows in open channels; Derivation of 1-D and 2-D shallow water flow equations; Consideration for non- hydrostatic pressure distribution

UNIT-II

Basics of numerical methods Finite-Difference methods Latest shock capturing Finite Volume methods for solving 1-D and 2-D shallow water flow equations

UNIT-III

Dam break flow, Flood routing in large channel networks

UNIT-IV

Knowledge about river behavior is essential for practicing hydraulic and water resources engineers. River Morphology (Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations etc.); Sediment Transport Mechanics (Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Sediment Transport Equations); Aggradation and Degradation; Local Scour at Bridge Piers and other Hydraulic Structures.

UNIT-V

Measurements in Rivers (Stage measurements, Channel geometry, Discharge, Sediment samplers and suspended and bed load measurement), Physical river Models (fixed and movable bed models; sectional models, distorted Models), Mathematical models for aggradations, degradation and local scour, River Protection and Training Works (Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures), river training works and flood protection structures, Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration.

Suggested readings:

1. *K. Subramanya, Open channel Flow, Tata McGraw Hill, 2015.*
2. *Ven Te Chow, Open Channel Hydraulics, Tata McGraw Hill, 2009.*
3. *Bansal, R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2018.*
4. *Modi P. N. & Seth S. M., Hydraulics & Fluid Mechanics, Standard Book House. 2018.*
5. *S K Garg, River Engineering, 1st Edition, Khanna Publications, 2018.*
6. K D Gupta, *River* Engineering, 1st Edition, Vayu Education of India, 2014.

Course Code	Course Title						Core/ Elective
PE309 CE	**STEEL STRUCTURES**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

The Objective of This Course is to

1) Know the IS code provisions as applicable for the designs.
2) Understand the material behavior and basics of design of steel structures.
3) Learn the design of various members along with the connections.
4) Explain the design principles of roof trusses

Course Outcomes

After Completion of this course, the student will be able to

1) Learn IS code provisions and basics of design of steel structures.
2) Design the different types of bolted and welded connections.
3) Design tension members of an steel structure.
4) Design a laterally supported and unsupported steel beam.
5) Design a compression members and roof trusses

UNIT- I

Materials and Specifications: Chemical composition of steel, types of Structural Steel, Residual stresses, Stress Concentration.

Basis of Structural Design: Codes and Specifications, Design Philosophies, working Stress Method, Limit State Method.

Loading and Load Combinations: Characteristic Loads, Dead Loads, Imposed Loads, Earthquake Loads, Wind Loads and Load Combinations. Partial safety factors for materials and loads.

Bolted Connections (Limit state method): Bolted Connections, Behavior of Bolted Joints, Design Strength of Ordinary Black Bolts, Design Strength of High Strength Friction Grip Bolts, Pin Connections, Simple Connections and Eccentric Connections.

Welded Connections (Limit State Method): Advantages of Welding, Types of Welds and Joints, Simple Connections and Eccentric Connections.

UNIT- II

Working Stress Method: Permissible Stresses, Slenderness Ratio, Net Area of Cross Section, Design of tension members, Design of Simple Compression Members.

Design of Tension Members (Limit State Method): Types of Tension Members, Design of Strands, Slenderness Ratio, Modes of Failure, Factors Effecting Strength of Tension Members, Design of Tension Members (Angles, Other sections and Rods), Lug Angles, Tension Member Splice.

UNIT- III

Design of Beams (Limit State Method): Types of Beams, Section Classification, Lateral Stability of Beams, Buckling of Real Beams, Behavior of Beams in Bending, Design of Laterally Supported and Unsupported Beams, Design of Compound Beams, Shear Strength of Beams, Maximum Deflection, Web Buckling and Web Crippling, Biaxial Bending and Unsymmetrical Bending.

UNIT – IV

Design of Compression Members (Limit State Method): Introduction, Possible Failure Modes, Behavior of Compression Members, Elastic Buckling of Slender Compression Members, Behavior of Real Compression Members, Sections of Compression Members, Effective Length, Design of Compression Members with Single Section and Built-up Sections (Symmetric in both directions), Lacing and Battening, Column Splices. Design of Column Bases (Limit state method): Design of Slab Base and Gusseted Base for Colum

UNIT- V

Design of Roof Trusses (Limit State Method): Types of Trusses, End Bearings, Spacing of Trusses and Purlins, Estimation of Loads with different Roof Coverings, Self-weight of Truss, Wind Effects, Design of Purlins for Dead Load, Imposed Load and Wind Loads. Detailed Design of Roof Trusses including Joints and Supports (only Angular Trusses)

Suggested readings:

1) *Subramanian. N, Design of Steel Structures, Oxford University Press, 2008.*
2) *Duggal S.K., Design of Steel Structures, 3rd Edition, Tata McGraw Hill Publishing, 2017.*
3) *Shiyekar M.R.,Limit State Design in Structural Steel, 2nd Edition, PHI Learning Pvt. Ltd., 2013.*
4) *Bhavikatti, S.S., Design of Steel Structures, 5th Edition, I.K. International Publishing House Pvt. Ltd. 2017.*
5) *P. Dayaratnam, Design of Steel Structures, S. Chand & Co. New Delhi, 2012.*
6) *Indian Standard Code – IS : 800-2007*

Course Code	Course Title						Core / Elective
PE310CE	**GROUND WATER ENGINEERING**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Hydrology & WR Engineering	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Introduction to well hydraulics problems and perspectives of ground water
2) Knowledge about various investigations related to ground water
3) Quality and management of ground water

Course Outcomes

After Completion of this course, the student will be able to

1) Understand the porous medium properties that control groundwater flow and transport, including porosity, hydraulic conductivity and compressibility.
2) Apply groundwater flow equations to confined and unconfined aquifers.
3) Understand Surface and Subsurface investigations for ground water
4) Derive effective hydraulic conductivity for various cases of heterogeneous subsurface formations.
5) Understand about groundwater quality recharge and salt water intrusion

UNIT –I

Well hydraulics and well construction, geo-physical explorations, groundwater quality and management of groundwater resources; Problems and perspectives regarding groundwater in India;

UNIT –II

Hydrogeology: Darcy's Equation; flow characteristics; general flow equations; unsaturated flow; Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic well losses; specific capacity,

UNIT –III

Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction),

UNIT –IV

Water Wells, Construction; completion, development, protection and rehabilitation of wells;

UNIT-V

Groundwater quality; Groundwater Management: Basin management, investigations, conjunctive use, modeling, artificial recharge; Saline water intrusion

Suggested readings:

1. *D.K.Todd, Ground Water Hydrology, John Wiley & Sons, Inc., USA.*
2. *H.M.Ragunath, Ground Water, Wiley Eastern Limited, New Delhi.*
3. *K.P.Karnath, Ground Water Ananment, Development and Management, Tata McGraw Hill Publishing Company New Delhi.*
4. *Walton, Ground Evaluation and Management, McGraw Hill.*
5. *Bouwer, Ground Water Hydrology McGraw Hill.*

Course Code	Course Title						Core / Elective
PE311CE	**GEOTECHNICAL DESIGN**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) To understand the objectives, necessity and scope of ground improvement techniques
2) To learn different methods of in situ densification of cohesive, cohesion less soils
3) To learn the classification, functions and applications of Geosynthetics in ground improveme
4) To appreciate different types of geosynthetic products and the functions served by each.
5) To understand the applications of geosynthetics in various civil engineering fields

Course Outcomes

After Completion of this course, the student will be able to

1) Ability to understand the necessity of ground improvement and potential of a ground for improvement.
2) To gain comprehensive understanding about the improvement of in situ cohesive soils as well as Cohesion less soils.
3) Comprehend different properties and test methods of geotextile & manufacturing process and design process of geosynthetic
4) Describe the different properties and test methods of geogrid and geonet.
5) Design geo-composites for basic functions like separation, reinforcement and so on.

UNIT- I

Introduction: Need for ground improvement, applications, and factors affecting - different mechanical, chemical, static and dynamic techniques - mechanical stabilization - blending of aggregate - Rothfunt's - Testing.

Chemical Stabilization: Lime, cement, bitumen, factors influencing -Design approach, construction procedure, laboratory testing, and additives. Suspension and solution grouts, principles, methods, equipment, applications, compaction grouting, jet grouting.

UNIT- II

Cohesionless Soils: In situ densification, vibro techniques -Mechanisms. Factors affecting, suitability number, compacting piles. Vibro replacement process.

Cohesive Soils: In situ densification, Pre-loading - Dewatering - sand drains. Sandwicks, geodrains, ropedrains, band drains-stone columns, lime piles - thermal and vacuum methods.

UNIT- III

An Overview of Geosynthetics: Introduction – Classification & basic description of Geosynthetics – manufacturing process – Over view of Geotextiles, Geogrids, Geonets, Geomembranes and Geocomposites.

Design Methods: Design by cost & availability – Design by specification – Design by function.

UNIT – IV

Geotextile Properties and Test Methods: Physical, Mechanical, Hydraulic, Endurance and Degradation properties.

Designing with Geotextiles: Geotextile functions and mechanisms – Designing for separation – Designing for reinforcement – Designing for stabilization – Designing for filtration – Designing for drainage – designing for multi functions.

UNIT- V

Designing with Geogrids: Designing for geogrid reinforcement, Geonets Properties and Test methods: Physical, Mechanical, Hydraulic, Endurance and Environmental properties.

Designing with Geonets and Geocomposites: Designing for geonet drainage- Geocomposites for separation – reinforcement – filtration – drainage – liquid/ vapour barriers, Construction Methods & Techniques Using Geosynthetics.

Suggested readings:

1. *J.E. Bowles, Foundation Design & Analysis,5th Edition, McGraw-Hill Edition, 2001.*
2. *P. Purushottam Raj, Ground Improvement Techniques, 2nd Edition, Laxmi Publications.2016*
3. *F. S. Fang, "Handbook of Foundation Engineereing",2nd Edition, Springer, 1991.*
4. *Rao, G.V. and Raju, G.V.S.S., Engineering with Geosynthesis, Tata McGraw-Hill Pub. Co., 1998*
5. *Robert M. Koerner, Designing with Geosynthetics, 6th Edition, Prentice Hall, 2012.*
6. *Manoj Datta and Gulati, S.K., "Geotechnical Engineering" 1st Edition, McGraw Hill Education (India), Pvt. Ltd., 2017.*

Course Code	Course Title						Core / Elective
PE312CE	**ENVIRONMENTAL IMPACT ASSESSMENT OF TRANSPORTATION PROJECTS**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Explain the concepts of environmental impact assessment and apply in the projects.
2) List and define various indicators such as terrestrial subsystems, Indicators aquatic subsystems, Socio-economic and able to Select various indicators for EIA studies.
3) Explain the impacts of transportation related components on environment
4) Explain and illustrate the methodologies for environmental impact assessment

Course Outcomes

On completion of the course, the students will be able to:

1) Describe the environmental imbalances, indicators and explain the concept of EIA
2) Identify and describe elements to be affected by the proposed developments and/or likely to cause adverse impacts to the proposed project, including natural and man-made environment;
3) Identify the negative impacts and propose the provision of infrastructure or mitigation measures
4) Assess the impacts of various development on environment
5) Summarize the methodologies for carrying out environmental impact assessment

UNIT - I

Introduction: Environment and its interaction with human activities - Environmental imbalances - Attributes, Impacts, Indicators and Measurements - Concept of Environmental Impact Assessment (EIA), Environmental Impact Statement, Objectives of EIA, Advantages and Limitations of EIA

The Environmental Protection Act, Pollution Act, Motor Act.

UNIT – II

Environmental Indicators: Indicators for climate - Indicators for terrestrial subsystems - Indicators for aquatic subsystems - Selection of indicators - Socio-economic indicators - Basic information - Indicators for economy - Social indicators - Indicators for health and nutrition - Cultural indicators - Selection of indicators.

UNIT-III

Environmental Impact Assessment for Transportation Projects: Basic Concepts, Objectives, Transportation Related Environmental Impacts – Vehicular Impacts – Safety & Capacity Impacts – Roadway Impacts – Construction Impacts, Environmental Impact Assessment – Environmental Impact Statement, Environment Audit, Typical case studies

UNIT-IV

Environmental Issues in Industrial Development: On-site and Off-site impacts during various stages of industrial development, Long term climatic changes, Green house effect, Industrial effluents and their impact on natural cycle, Environmental impact of Highways, Mining and Energy development

UNIT – V

Methodologies for Carrying Environmental Impact Assessment: Overview of Methodologies, Adhoc Checklist, Matrix, Network, Overlays, Benefit Cost Analysis, Choosing a Methodology.

Environmental Audit & Environmental legislation: objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

Suggested readings:

1. *Jain, R.K., Urban, L.V., Stracy, G.S., (1991), "Environmental Impact Analysis", Van Nostrand Reinhold Co., New York*
2. *Rau, J.G. and Wooten, D.C., (1996), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York*
3. *Canter, L.W., (1997), "Environmental Impact Assessment", McGraw Hill Pub. Co., New York*
4. *Grand Jean, E. Gilgen A., "Environmental Fact ors in Urban Planning", Taylor and Francis Limited, London, 1976.*
5. *UNESCO, (1987), "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development", UNESCO/UNEP, Paris.*

Course Code	Course Title						Core / Elective
PC361CE	**ENVIRONMENTAL ENGINEERING LAB**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1) Characterization of water and wastewater to ensure security and well-being of humanity
2) Verify the efficiency of certain water treatment processes
3) Understand the importance of coagulation

Course Outcomes

1) Students will have the ability to: compile and use of experimental information
2) Ability to perform experiments on water sample for physical and chemical tests
3) Ability to critically analyze and interpret data and present results on water samples

List of Experiments:

1. a) Determination of total dissolved solids
   a) Determination of total suspended solids
   b) Determination of fluorides
2. Determination of pH and EC
3. Determination of total hardness
4. Determination of alkalinity
5. Determination of chlorides
6. Determination of sulphates
7. Determination of MPN
8. Determination of residual chlorine
9. Determination of optimum alum dosage
10. Determination of BOD
11. Determination of COD

Suggested readings:

1. *Fair.G.M. and Geyer. J.C.* ***"Water and Wastewater Engineering"****, Vol. I & II. John Wiley & Sons Inc., New York, 2010.*
2. *White. J.B****."Wastewater Engineering",*** *2nd Edition, Edward Arnold. London, 1978*
3. *Hammer. M.J. and Hammer. M.J.Jr.,* ***"Water and Wastewater Technology",*** *Prentice-Hall of India Pvt.Ltd., New Delhi, 1998.,*

Course Code	Course Title						Core / Elective
PC362CE	**COMPUTER AIDED CIVIL ENGINEERING DRAFTING, ANALYSIS & DESIGN LAB**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	0	0	0	2	**25**	**50**	1

Course Objectives

1) To develop skill to use STAAD III, ANSYS etc
2) To develop skill to use software to create 2D and 3D models.

Course Outcomes

1) Able to write C program for civil engineering problems.
2) Able to analyze certain structural elements using Excel
3) Able to analyze various structural elements using STAAD

List of Experiments:

A) Introduction:

Main frame - Mini and Micro computers - system configuration - Functions – Hardware, Software, Operating System Basics - File Processing Techniques - High level languages – packages.

B) Development and Implementation of Programs for the following in C Language:

1. Solution of simultaneous equations by Gauss – Jordan method.
2. Solution of non-linear equations using Newton-Raphson technique.
3. Drawing the S.F and B.M. diagrams for simply supported beams and cantilever beams subject to point, udl and uniformly varying loads
4. Analysis of plane, pin jointed frames.
5. Deflection of cantilever and simply supported beams.
6. Limit state Design of R. C. Rectangular and T – beams.
7. Design of tension and Compression Steel Members.
8. Expert Systems for Classification of soil.
9. Water surface profiles.
10. Determination of friction factor
11. Stability of slopes

C) Development and Implementation of Programs for the following using Excel:

12. Design of R.C. Retaining Walls
13. Design Profile of masonry dams
14. Design of Two-way slab and flat slab.

D) Miscellaneous:

15. Analysis of 2D Truss using STAAD-III
16. Analysis of 2D and 3D Rigid Frames using STAAD-III
17. Analysis of 3D pin jointed frames using ANSYS

18. Analysis of suspension cables using ANSYS
19. Design of Footings and Retaining Walls using STAAD-III
20. Structural Design of the following, using STAAD-III and detailing of the same using AUTO CAD
    a. R.C. Beams
    b. R.C. Slabs
    c. R.C. Columns and Footings
    d. Steel beams
    e. Steel columns
21. Design of circular water tanks using STAAD-III
22. Deflection and Stresses in beams using FEAST
23. Building Drawing, including perspective view using Floor Plan 3D
24. Concrete mix design and mathematical calculations using MATHCAD

Note: At least **twelve** experiments should be conducted in the Semester

Suggested readings:

1. *Balaguruswamy. E, Object – Oriented Programming In C, Tata Mc Graw Hill.*
2. *STAAD Package Manual*
3. *ANSYS Package Manual.*

Course Code	Course Title						Core / Elective
PC363CE	**HYDRAULICS LABORATORY**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**0**	**0**	**0**	**2**	**25**	**50**	**1**

Course Objectives

1) Provide understanding of practical applications of open and curved channels
2) Application of force concepts on jets and hydraulic machines
3) Determination of characteristic curves of turbines and pumps

Course Outcomes

1) Competence in understanding flow phenomenon in open channels
2) Ability to analyze the force acting due to jets concept and its application in hydraulic machines
3) Competence in working principles of hydraulic pumps and turbines

List of Experiments:

1. Determination of roughness coefficient in an open channel
2. Determination of a vane coefficient
3. Study of universal characteristic curves of a Pelton Wheel
4. Study of universal characteristic curves of a Francis turbine
5. Determination of super elevation in an open channel
6. Determination of basic characteristics of a hydraulic jump
7. Verification of Froude's Model law in an open channel
8. Determination of flow around an Aerofoil / circular cylinder
9. Study of main characteristic curves of a Centrifugal pump
10. Determination of Minor losses in pipe

Suggested readings:

1. *S. K. Som, and Biswas, G, 'Fluid Mechanics and Fluid Machines', Tata McGraw-Hill Publishing Co., New Delhi, 1998*
2. *Yuan, S. W., 'Foundation of Fluid Mechanics', Prentice-Hall India Pvt. Ltd., New Delhi, 1976*
3. *C.S.P. Ojha, R.Berndtsson, P.N. Chandramouli, 'Fluid Mechanics and Machinery', Oxford University Press, New Delhi, 2010*
4. *A.K.Mohanty, 'Fluid Mechnics', Prentice-Hall India Pvt. Ltd., New Delhi, 1994*
5. *P.N. Modi, 'Hydraulics and Fluid Mechanics Including Hydraulics Machines', Standard Book House, New Delhi, 2013.*

OPEN ELECTIVES OFFERED BY CIVIL ENGINEERING DEPARTMENT

Open Elective-I	Open Elective-II
Remote Sensing & Geographical Information	Principles of Green Building Practices
Road Safety Engineering	Disaster Mitigation & Management

Course Code	Course Title						Core / Elective
OE____ CE	**REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives: The objectives of the course is to provide

1) Basic concept of Remote Sensing and know about different types of satellite and sensors.
2) Comprehend concepts of GIS and its applications
3) knowledge of GIS software and able to work with GIS software in various application fields

Course Outcomes

On completion of the course, the students will be able to:

1) Procure knowledge on Remote Sensing, different types of satellite and sensors
2) Understand the principles of satellite remote sensing, Able to comprehend the energy interactions with earth surface features, spectral properties of water bodies
3) Understand the basic concept of GIS and its applications, know different types of data representation in GIS
4) Understand data types apply the principles of filters
5) Understand and Develop models for GIS spatial Analysis

UNIT-I

Basics of Remote Sensing: Definition, History, Advantages, Aerial Photography and Satellite Remote Sensing, Components of Remote Sensing System: Energy Source, Energy-Atmosphere Interaction, Energy Interaction with Atmosphere and Surface Materials, Spectral Signatures.

UNIT- II:

Remote Sensing Platforms: Aircrafts and Satellites, Orbital Characteristics of Sun-synchronous Earth Resource Satellites and Geostationary Communication - Special Purpose Satellites., Remote Sensing Sensors: Types of Sensors, Active and Passive- Framing Systems (Cameras) - Scanning System, Sensor Characteristics: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.

UNIT-III

Introduction to GIS: Map, definitions, representations-Point, line, polygon, common coordinate systems, map projections-Transformations-Coordinate system - Map analysis. History of development of GIS -Standard GIS packages, Applications of GIS

UNIT-IV

Data Entry, Storage and Maintenance: Data types - spatial, non spatial (attribute data) Data structure, data format - Point line vector-Raster - Polygon - Object structural model - Filters and files data in computer, Digital elevation data, data compression.

UNIT-V

GIS Analysis Functions for Integrated Analysis of Spatial and Attribute Data : Retrieval and classification functions : Overlay operations, neighborhood operations, connectivity functions, output formatting, map annotations text pattern and line styles, graphic symbols,

cartographic molding by GIS analysis procedure with an example.

Presentation of Geo-data and Analysis: Types of output data - Types of errors elimination and accuracies-sampling-Components of data quality.

Suggested Reading:

1. *Kang-Tsung Chang, Introduction to GIS, Tata McGraw Hill Edition.*
2. *Burrough P.A., Principles of GIS for Land resource Assessment, Oxford Publication.*
3. *Lilly and John weily, Remote Sensing and Image Interpretation.*
4. *Stan, Geographic Information Systems A management Perspective.*

Course Code	Course Title						Core / Elective
OE ___ CE	**ROAD SAFETY ENGINEERING & MANAGEMENT**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) Introduction to various factors considered for road safety and management
2) Explain the road safety appurtenances and design elements
3) Discuss the various traffic management techniques

Course Outcomes

At the end of the course, the students will be able to

1) Understand the fundamentals of traffic safety analysis
2) Analyze Accident data
3) Remember the concepts of road safety in urban transport
4) Apply crash reduction techniques
5) Design of urban Infrastructure considering safety aspects.

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and Road Equipments, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

Traffic Signals & Road signs: Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. *Kadiyali L.R,. Traffic Engineering and Transport planning, 9th Edition, Khanna Tech Publishers, 2013.*
2. *C.E.G.Justo, A. Veeraragavan and S.K.Khanna, Highway Engineering, 10th Edition, Nem Chand Publishers, 2017.*
3. *Donald Drew, Traffic Flow Theory Chapter 14 in Differential Equation Models, Springer, 1983*
4. *C.Jotinkhisty and B. Kent Lall, Transportation Engineering – An Introduction, 3rd Edition, Pearson publications, 2017*
5. *Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson, Handbook of Road Safety measures, second Edition, Emerald Publishing, 2009.*
6. *Highway Research Programme (NCHRP) Synthesis 336.A synthesis of Highway Research Board, Washington D.C, 2016.*

Course Code	Course Title						Core / Elective
OE ___CE	**PRINCIPLES OF GREEN BUILDING PRACTICES**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	L			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) To impart knowledge of the principles and practices of the green buildings.
2) To know the importance of sustainable use of natural resources and energy.
3) To understand the principles of effective energy and resources management in buildings.
4) To bring awareness of the basic criteria in the green building rating systems.
5) To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1) Define sustainability and a green building, along with its features and benefits.
2) Describe the criteria used for site selection and water efficiency methods.
3) Explain the energy efficiency terms and methods used in green building practices.
4) Select materials for sustainable built environment & adopt waste management methods.
5) Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings, definition of sustainability, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, and so on.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, Solar Heat Gain Coefficient, U-Values for facade materials, efficient lighting technologies, energy efficient and BEE rated appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of NET ZERO buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Local building materials.(b) Natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks. (c) Materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) Reuse of waste and salvaged materials.

Waste Management: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management.

UNIT-V

Indoor Environmental Quality: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. *IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.*
2. *GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.*
3. *K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao, Alternative building materials and technologies, New Age International Private Limited, 2017*
4. *G. D. Rai, Non-Conventional Energy Resource, Khanna Publishers, 2004.*
5. *Energy and Resource Institute, Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi, 2009.*
6. *Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010.*
7. *Charles J. Kibert, Sustainable Construction - Green Building Design and Delivery, 4th Edition, John Wiley & Sons, New York, 2016.*
8. *Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009.*

Course Code	Course Title						Core / Elective
OE ___CE	**DISASTER MITIGATION AND MANAGEMENT**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	L			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

1) To impart knowledge of the principles and practices of the green buildings.
2) To know the importance of sustainable use of natural resources and energy.
3) To understand the principles of effective energy and resources management in buildings.
4) To bring awareness of the basic criteria in the green building rating systems.
5) To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1) Define sustainability and a green building, along with its features and benefits.
2) Describe the criteria used for site selection and water efficiency methods.
3) Explain the energy efficiency terms and methods used in green building practices.
4) Select materials for sustainable built environment & adopt waste management methods.
5) Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, and Capacity – Disaster and Development, and disaster management.

UNIT-II

Disasters: Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

UNIT-III

Disaster Management Cycle and Framework: Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.

During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation.

Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR.

UNIT-IV

Disaster Management in India: Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter Governmental Agencies.

UNIT-V

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.

Suggested Reading:

1. *Rajib, S and Krishna Murthy, R. R, Disaster Management Global Challenges and Local Solutions" CRC Press, 2009.*
2. *Navele, P & Raja, C. K, Earth and Atmospheric Disasters Management, Natural and Manmade. B. S. Publications.2009*
3. *Battacharya, T., Disaster Science and Management. Tata McGraw hill Company, 2017*
4. *Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi*
5. *An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi*
6. *Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006*
7. *Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur*
8. *Disaster Management Act 2005, Publisher by Govt. of India*
9. *Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management*
10. *National Disaster Management Policy, 2009, Govt. of India*
11. *Jagbir singh, Disaster management–Future challenges and opportunities, I.K. International publishing house, 1st edition, 2007.*
12. *Coppala P Damon, Introduction to International Disaster management, Butterworth-Heinemann, 2015.*